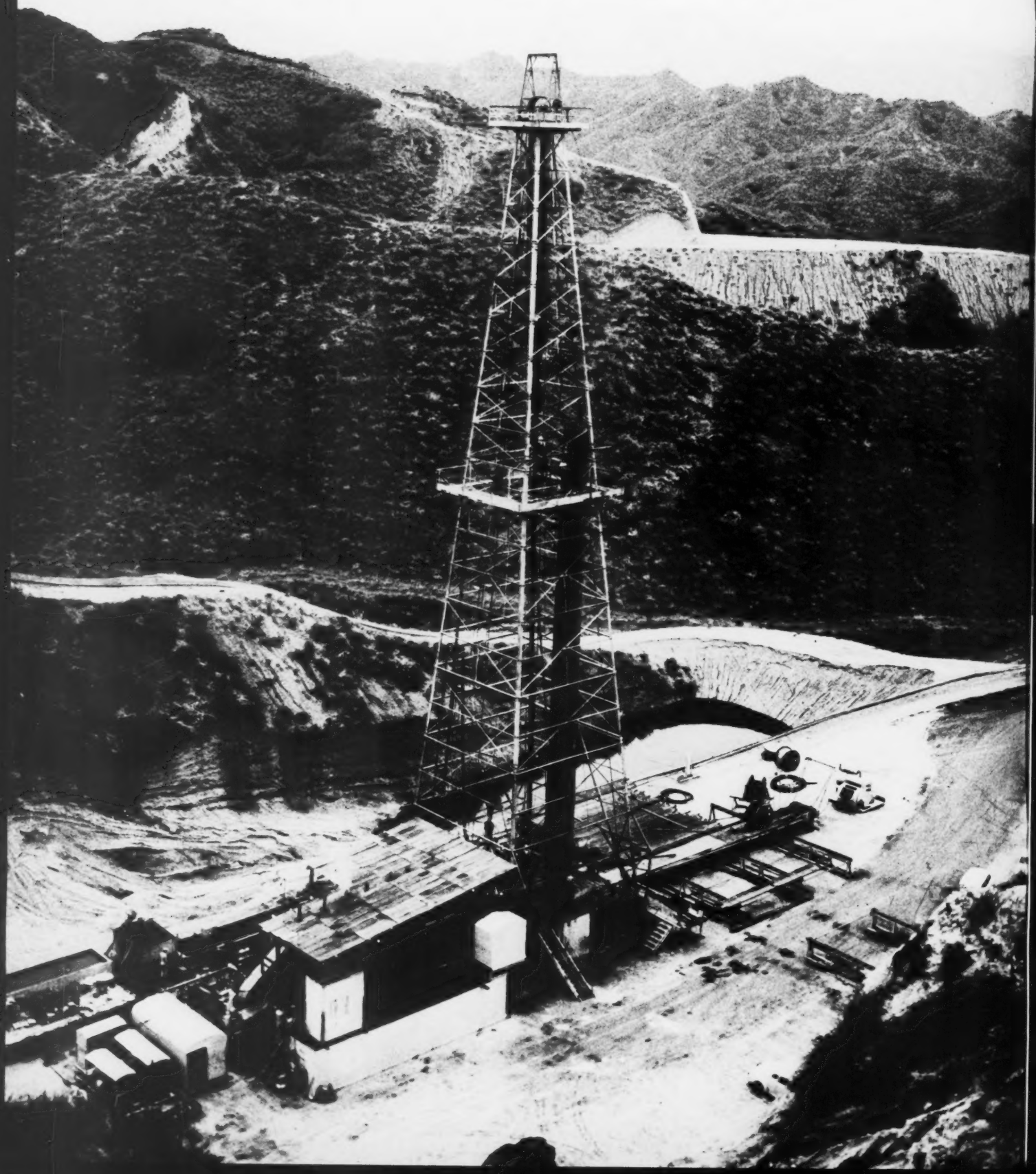
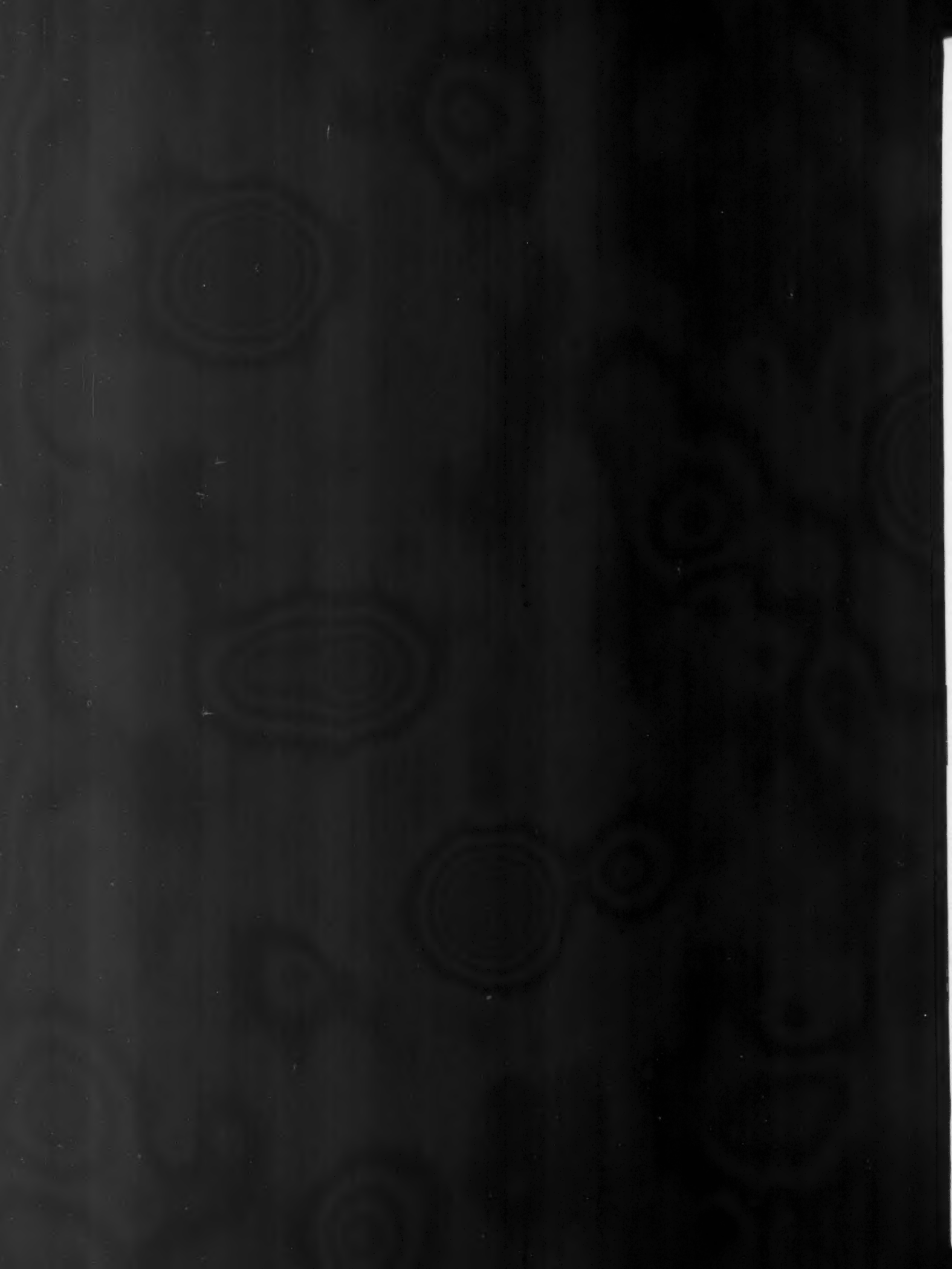
Loading Oil at Harbor Island — *Bob Wygant*

The Humble Way

JULY-AUGUST, 1957

Lonely well in Humble's Castaic Junction Field symbolizes problems of mountain drilling operations. Locations and roads must be gouged out of steep hillsides.





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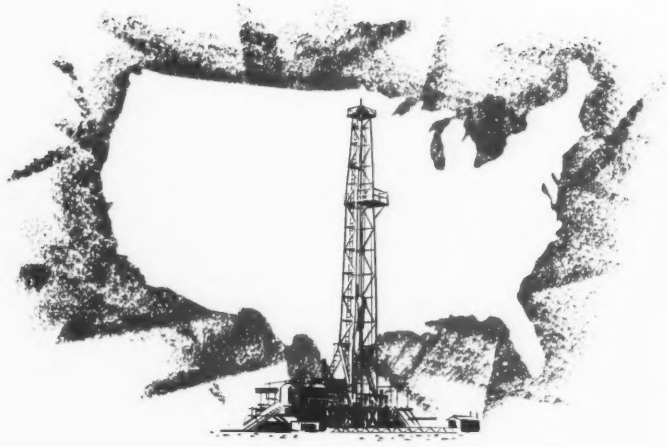
Vol. XIII No. 2



Of Problems and Progress

By Morgan J. Davis

President, Humble Oil & Refining Company

THE petroleum industry's problems, it sometimes seems, become more numerous and more complex with each passing year. Certainly they are just as challenging today as they have ever been in the history of the industry.

But problems go with life. They also go with progress. At Humble, for example, we are currently observing our 40th anniversary. In looking back over the Company's history, one notices that neither Humble nor the industry has ever been free of major problems for very long at a time. Moreover, these problems seemed just as knotty and difficult of solution then as do those that confront us today.

Conservation is an excellent case in point. Here was a problem that had the industry as bitterly divided on methods and procedures as our atomic scientists are today on the dangers of radioactive fallout. Back in 1917, the year Humble was organized, flush production was the thing regardless of the effect on ultimate recovery. Waste was rampant, and the oil business was a feast-or-famine proposition. In the late 20's and early 30's, when the conservation movement began to gain momentum, obstacles galore were placed in its path—legal, political, and economic. It took hard work, good faith, and a spirit of compromise, but this great problem was finally resolved.

As is usually the case, it is the energy-consuming public which has benefited just as much as the industry from the sound solution to the conservation problem. In 1917, the oil output for the entire country was 919,000 barrels a day. At the same time, untold amounts of oil and gas were wasted and lost forever. Today, just 40 years later, we are producing more than 8 million barrels a day of oil and liquid hydrocarbons. And to that can be added a reserve producing capacity of something like 2 million barrels a day.

The moral is that problems in the petroleum industry are just as sure as death and taxes, but it is very much in the public interest that sound solutions be found to these problems.

This should become even more evident as time goes on. Just a few weeks ago, as you may have noticed, the Census Bureau estimated that America's population has now passed 171 million. Our annual rate of growth was placed at 3 million—

This article is based on a talk that Mr. Davis made on June 11, 1957, to the Gulf Coast Petroleum Writers in Houston.

"It is absolutely vital... that we keep our exploratory

the equivalent each year of three new cities the size of Houston. Hand in hand with this growth in population must inevitably go an increase in the demand for energy. And if our standard of living is to be maintained, larger and larger amounts of energy must be developed and made available.

That means, among other things, larger and larger amounts of oil and gas. In just the last 10 years, for instance, the free world's consumption of petroleum has more than doubled. In 1946, the United States and other free nations used 7.1 million barrels of oil a day. Last year, they used 15.4 million barrels—over twice as much as they did in that first postwar year. For the United States, another 4½ per cent gain is estimated for 1957. For the rest of the free world, an even larger increase is expected. Last year, the increase in foreign demand was about 12 to 13 per cent.

These rates of growth foreshadow some tremendous figures a few years down the road. By 1965, one economic study estimates, America's domestic consumption of oil and liquid hydrocarbons will be in the neighborhood of 13 million barrels a day—an increase of more than 40 per cent over that of today. The other free nations are expected to need about as much as we do by then which will mean an increase in foreign demand of more than 100 per cent.

Much of this increased demand, particularly that abroad, can be met from Middle East and other foreign sources. As far as this country is concerned, however, if we are to remain reasonably self-sufficient as far as petroleum is concerned, our oil-finding effort during the coming years will have to be more vigorous and enterprising and skilled than it has ever been before.

What are our prospects for reaching that goal? Can we look forward to a continuation of the industry's story of growth and progress? That remains to be seen. To a great extent it will depend upon our ability to resolve the problems now facing the industry.

Tremendous quantities of oil yet to be found in this country

As to oil-finding possibilities, however, I personally lean toward an optimistic view—at least during our lifetime. I believe there are still tremendous quantities of oil to be found in this country, enough to power our industrial machine for many years to come, and I believe that the petroleum industry—if encouraged to do so and if not unduly hampered by artificial restraints—will proceed to find that oil.

It is absolutely vital, I think—vital to both the economic well-being and the national defense of our country—that we do keep our exploratory and development operations going full speed ahead. For finding and producing oil, as we have all seen time and time again, is a dynamic, long-range project. We cannot twiddle our national thumbs, and postpone our drilling and development to some later date, and still expect to have the oil available when urgent needs arise. This, in my opinion, is the simple but complete answer to those who would set aside undeveloped areas as reserves for future use and thereby "stockpile" oil and to those who argue that excessive imports will allow us to "save" our domestic supply.

Daily offshore production supplies nation for about 15 minutes

Offshore Louisiana is a good example of just how long it takes to develop oil. The industry, as you know, has been operating off Louisiana for more than 10 years. Literally hundreds of millions of dollars have been invested there in leasing and drilling. The area has an extraordinarily high ratio of successful wells. But there have been problems, as there will always be problems, and it is estimated that for the year 1957 the average daily production off the Louisiana coast will be only 103,000 barrels. That's enough to supply the nation's consumers for about 15 minutes.

The element of time is but one factor entering into the search for new reserves. Another is money. Along with increasing demand, at the same time that petroleum is becoming increasingly vital to our way of life, oil is also becoming far more expensive to find and develop.

For one thing, for example, we are having to drill considerably deeper to find oil. Back in 1937, we had to drill only 28 feet for each thousand barrels of new oil added to reserves by new discoveries, extensions, and revisions. Last year, we had to drill a little more than 78 feet for each thousand barrels of new oil. Average well depth increased from 2985 feet in 1937 to 4022 feet in 1946. And the deeper we go, the closer the drilling cost curve approaches the vertical.

Another reason for increased costs has been the move to offshore and other hard-to-reach areas. The average cost of drilling an offshore well is about six times as much as that of a well drilled on dry land. While the success ratio is consider-

tory and development operations going full speed ahead"

ably higher out on the Continental Shelf, the fact remains that each dry hole out there is a much bigger drain on a company's budget. The Four Corners Area is another place where terrain and climate pose some costly problems. So is Alaska, where Humble, after three or four years of exploratory work, is now the operator in drilling a wildcat jointly with Shell.

To all such factors must be added the general inflationary pressures of the postwar years. It costs more to do almost anything these days.

Oil industry's future depends upon the needed flow of risk capital

The petroleum industry will spend this year about 5 billion dollars on exploration, drilling and producing facilities. And even that huge amount may have to be increased if we are to stay apace of anticipated demand. It seems fairly certain that for some time to come the industry's oil-finding limitations will be not so much geologic and technological in nature as they will be economic.

This means, in the final analysis, that if we are to have enough oil, then we must be prepared to raise and spend the amount of money required to find that oil. It means that the government should follow taxing policies which will stimulate the needed flow of risk capital. It means that all of us—the general public as well as the entire industry—must become more and more conscious of the magnitude of the investments required.

To keep pace with demand over the next 10 years, Dr. R. J. Gonzalez recently estimated, the industry will have to drill some 700,000 wells. It will have to pay out some 60 to 70 billion dollars for the development of new oil and gas resources. To finance a program of this magnitude, producers will have to risk the capital recovered from earlier investments through depreciation and depletion. They will also have to plow back about half of their net income after taxes. Large additional sums will have to be raised by means of stock, bonds, or loans.

There are several factors which could be a drag on this investment process. They fall into two general categories.

On the one hand are the problems that nature has placed in our way; the occurrence of oil in the out-of-the-way and hard-to-get-to places; the need to drill to far greater depths; the fact that oil must be found and producing capacity developed far in advance of actual need; the cost of carrying this reserve producing capacity.

On the other hand are the man-made problems, and these, I think, are at this time a much more serious threat to our ability to produce. There is little need to go into these problems here. You know them well—federal control over natural gas, the harassment of the industry through repeated government investigations, the attacks on percentage depletion, the threat of other forms of restrictive legislation, and—not least of all—the divided front which too often crops up within the industry itself.

An example of the last-named problem is the imports question. Because of imports, we have a strange economic paradox in this country. Demand is steadily increasing, and the long-range need is for more and more domestic production. Our national security requires the same. At the same time, however, we are faced with a sharp reduction in the number of producing days in Texas; gasoline and heating oil inventories are climbing; and many refineries—Humble's included—have cut back their runs. The principal reason for this paradox, of course, is the continued increase in imports.

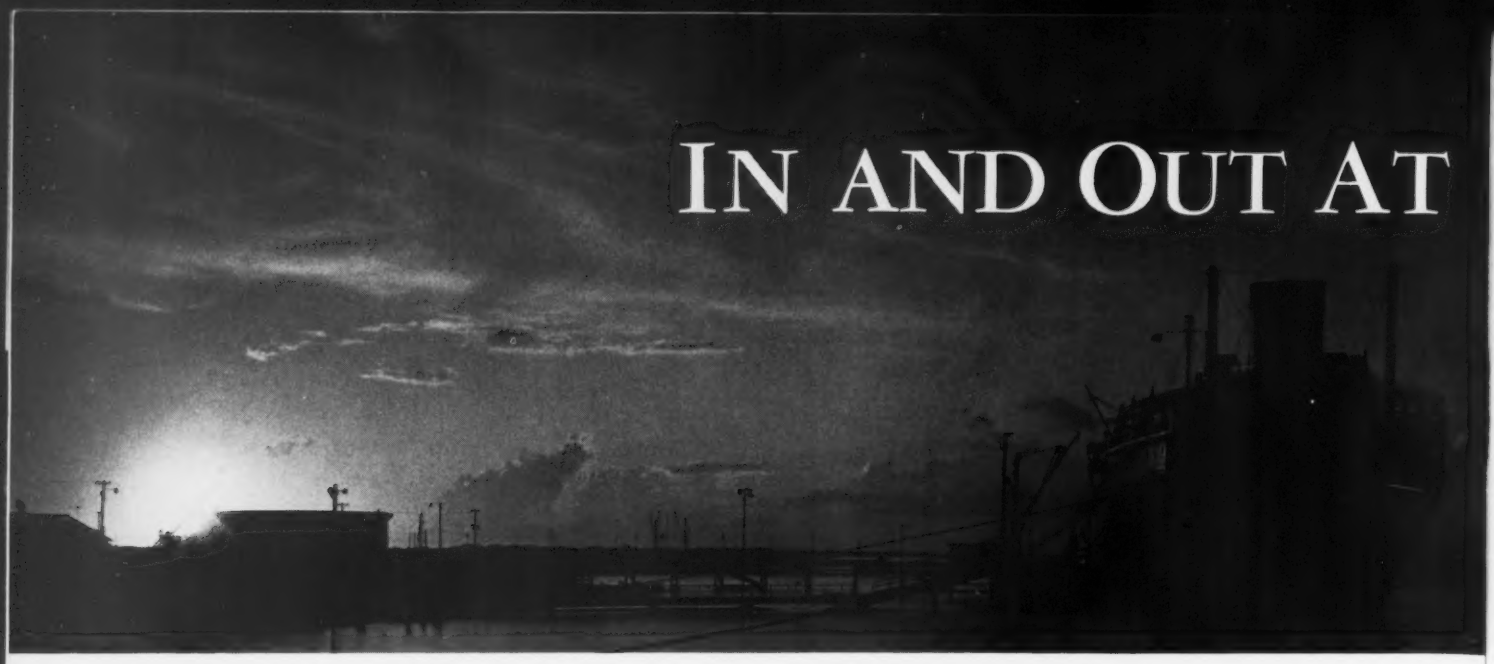
Excessive imports of foreign oil would be against our national interest

Most domestic producers, I believe, do not object to imports so long as they are held to a reasonable figure. It would be most unwise, however, and very much against our national interest, to permit an excess of foreign oil to deprive the domestic producing industry of the economic resources it needs if it is to find and develop the maximum amount of oil it is capable of finding and developing.

If the domestic industry is not allowed to find and have ready the oil it is capable of finding, then to all practical purposes we have lost that oil. We shall have hastened the day when America becomes dangerously dependent on foreign oil.

A problem such as this, however, is one we can and must do something about. With study and work, with tolerance and understanding, and possibly even with legislation, it can be resolved fairly and equitably—and so can most of the other man-made problems that plague us today. It is a little too Utopian to expect that great day when all the industry's troubles will roll away, but I do believe the time is coming when oil, to borrow Arthur Krock's words, will no longer be "a bad word which politicians need only to utter to arouse prejudice against useful legislation and good citizens."

IN AND OUT AT



As sun rises from Gulf over Harbor Island tank farm, an Esso supertanker sits in lazy silhouette, taking on cargo through some of the world's fastest crude oil moving equipment. Team of 47 Humble Pipe Liners use it to load tankers safely at all hours, in all weather.

For 30 years and one billion barrels, Humble's crude oil loading terminal at Harbor Island has been pivot point for world's tankships

RIDING high in the water, the big tanker had just been nursed into Harbor Island Terminal's Dock No. 1 by two tugboats and secured with massive mooring lines.

Her first mate leaned over the bridge railing and, cupping his hands to make a megaphone, called to the Humble Pipe Line dockmaster on the T-dock below. "Ahoy, there," he shouted; and then imitating a motorist at a service station, "Fill 'er up."

Filling ocean-going tankers with crude oil is a job that Humble Pipe Line crews have handled with a maximum of speed and safety—and a minimum of fanfare—for almost 30 years. But this tanker— the *Esso Reading*—was unique. Arriving on July 12, a special lot befell her. Into her honeycombed compartments streamed the *billionth* barrel of oil delivered by Harbor Island Terminal since the first tanker was loaded there in 1928.

A billion barrels of oil represents a sizable lake of liquid energy. It would fill 3,952,000 railroad tankcars. And that would make up into a train 29,120 miles long—enough to circle the earth at the equator with plenty left over to stretch from Chicago to Paris.

Harbor Island, as one of Humble's two crude oil loading terminals, is the oil spigot at the end of a network of pipe lines extending into Southwest Texas and far West Texas. From this spigot, oil gushes into tankers flying a hundred different flags on their way to fulfill the needs of oil-thirsty countries around the world.

Harbor Island itself is a 230-acre, man-made island near the entrance of the ship channel from the Gulf of Mexico to the Port of Corpus Christi. Its location so near the Gulf, but in protected waters, along with the terminal's high-capacity loading equipment, makes it one of the fastest turn-around ports in existence.

A modern supertanker is a restless lady who waits for no man. She is literally here today and gone tomorrow. Since it costs more than $2000 a day to keep her at dockside, she usually doesn't *wait* for tomorrow. The new Esso supertankers often leave their berths 12 hours after arrival, loaded with more than 200,000 barrels of crude. In 1954, one left port after only six hours, 19 minutes—a record.

Gull's-eye View shows docks and tank farm with tanker being turned around in Corpus Christi ship channel. Fishing village of Port Aransas is across the channel to the left.

T HARBOR ISLAND

The *Esso Zurich,* in and out at Harbor Island recently, took a little longer. The *Zurich* is eight years old, made her maiden voyage to Harbor Island in 1949. With a capacity of 238,000 barrels, she was the largest Esso tanker afloat at that time. Now, there are eleven more like the *Zurich;* in addition, she has two big sisters—*super*-supertankers that can carry *318,000 barrels.* Esso's tanker fleet, the largest private one flying the U. S. flag, is Harbor Island's biggest customer.

Alongside in Early Morning

The *Zurich* arrived in dead of night. Her master had radioed Humble's marine department representative that her E.T.A. (estimated time of arrival) on the channel bar was 2 a.m. Forty minutes later, after taking on a pilot, she was turning around in the channel alongside Harbor Island and having her 628-foot frame sidled up to the dock by tugs. Tom Mathisen, Humble Pipe Line dockmaster, and his crew of four were standing by. Oil transportation is no eight-to-five job. When the tankers come in, you fill them—even if it's two o'clock in the morning.

As soon as she nestled alongside her berth, the *Zurich's* crewmen swirled sandbag-weighted throwlines around their heads like slingshots, and flung them to the lighted dock below. In turn, Humble dockmen pulled ashore manila mooring lines and tied them fast. Meanwhile, the *Zurich's* pumps hummed, beginning the four-hour task of belching out thousands of gallons of seawater ballast. Without ballast, a tanker sailing light would suffer severe stresses and be so lively, especially in raw weather, that its crew could scarcely stand.

Shortly after 7 a.m., dock workers moved four serpentine, 8-inch rubber hoses aboard the *Zurich* with the help of an electric-powered boom. A smaller hose was hoisted on deck to deliver bunker fuel for the ship's boilers. The morning sun was up now, and hot—the dockmen's shirts stuck to their backs in sweaty adhesion. Connections were made. Valves were opened. The loading was underway. The *Zurich* was beginning its 202,000 barrel gulp of West Texas blended crude.

Over all the loading scene, an atmosphere of caution prevailed. Smoking, of course, is strictly prohibited. A ground wire, carefully checked by the chief officer and dockmaster, is connected from the ship to the dock to prevent sparks. The telephone in the Humble dock shack is of the anti-spark variety. Tools are of non-ferrous metals. Photographers are not even allowed to take flashbulb pictures. Foamite lines, fire extinguishers and hoses stand ready. It is a tribute to the caution of the men, encouraged by regular safety meetings, that this equipment never has been used.

Once loading is underway, machines do most of the work. *Zurich* crewmen, having finished morning chores and lunch on board, set out on foot for Port Aransas, across the channel. First, though, they sign out with the Nueces County deputy sheriff at the end of the gangplank. He lets only authorized persons leave or board the ship. Personnel from foreign ships are checked out by a customs agent.

Port Aransas is but a mile as the gull goes and a little farther by foot and ferry, but there is little time for visiting seamen to enjoy the diversions of shore leave. Fast turn-arounds at Harbor Island see to that.

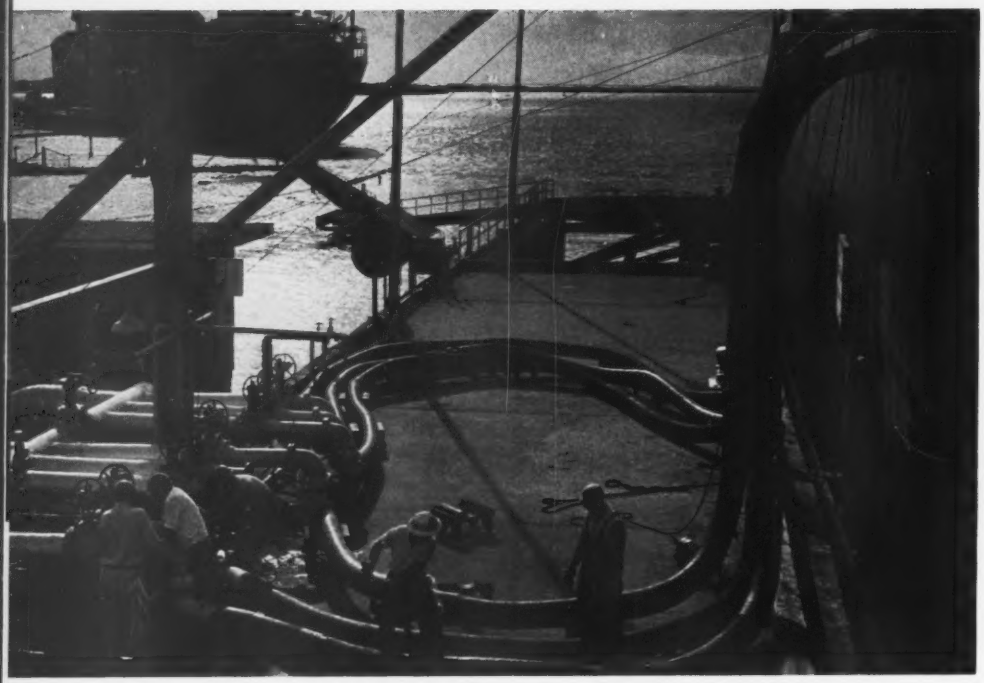
Ship's Agent Aboard First

While some Humble people go about the task of moving eight and a half million gallons of oil into the *Zurich's* hold, others busy themselves with attending to the ship's personal needs. The first man aboard was Herman Teller, Humble's marine representative who went directly to the master's stateroom to confer with the ship's captain. A ship's agent to handle all the tanker's business while in port, Teller orders provisions, stores, repairs, and medical service; furnishes payroll money; hires crew members; and makes necessary arrangements with the Customs Service, local consulates, and quarantine officers.

Eleven hours later, its great thirst slaked, the huge tanker slumped low in the water. The gangplank, once a steep, slippery hill, was level between ship and dock. Now a Humble gauger checks the level of the ship's tanks. Valves are

Tugboats turn tanker around before nudging it carefully up to concrete dock. Dockmaster and crew of four are waiting.

Mooring line slack is reeled in to keep tanker snug against dock. Note safety screen, dockman's hard hat and gloves.



Six rubber hoses of eight-inch diameter are hoisted aboard, affixed to ship's intake; two tankers can be loaded simultaneously at the peak rate of 55,000 barrels an hour.

Valves are opened and switches thrown; nearby the pump station begins to hum.

During loading, Supt. Gerbig, right, checks flowchart with the dockmaster.

closed. Connections are broken. Crewmen guide the snaking rubber hoses back into neat, curving rows on the concrete dock. With a series of hoarse blasts, the supertanker summons a waiting tug. Mooring lines are thrown off and reeled aboard.

At 6:30 p.m., 16 hours after arrival, the *Zurich* puts out to sea with an oil cargo twice her own weight. Route: around Florida to the Atlantic seaboard, the water highway of 50 per cent of operating tankers. Destination: Baltimore. Sailing time: four to five days.

A Look at Harbor Island

Harbor Island originally was a shapeless marsh, often submerged. When the ship channel was dredged to Corpus Christi in 1927, the island was one of the by-products. Today the island is built up as much as 13 feet above sea level. That part of its acreage still under water is being reclaimed yearly as new dredging clears silt from the channel floor.

The ship channel is the southern boundary of Harbor Island. Across from it is Mustang Island which gives the harbor protection from the open Gulf and its turbulent surf.

Still, the storms have come. In 1945, winds over 100 miles per hour swept the island, knocking out the causeway and damaging the dock area. Back in June of 1936, when another hurricane ripped into Harbor Island, a Humble executive and his wife on a fishing trip took overnight refuge on a berthed tanker. On waking the next morning, they found the vessel torn away from the docks and stuck in the mud across the channel. Mooring hooks as big around as a man's forearm were straightened out like fine wire. Four empty tanks on the tank farm were crushed like paper bags.

Today, a stone rip-rap, 10 feet high, fronts the channel and a pump system stands ready to quickly fill empty tanks with sea water in case of storm.

Seamen Sometimes Have Reunions

Harbor Island is a place of many moods. Sometimes, with a gloomy sky and empty ship berths, it is a lonely place. At others, when the tankers and the weekend fishing parties come, it is as active as many a Gulf Coast resort. Occasionally, it is a place of reunion for tanker seamen and their families. This is true, for example, of Captain A. Peterson, master of the *Esso Gloucester*. Each time his supertanker docks at Harbor Island, Capt. Peterson is met by his daughter, her husband (a Humble employee at nearby Victoria) and their three children, who have come to see their seafaring Granddaddy.

When the *Gloucester* docked at Harbor Island last January, Capt. Peterson brought unscheduled cargo—the captain and eleven crewmen of the *Santa Gloria*, a Honduran banana boat. The 133-foot craft had sprung a leak and sunk in the Gulf en route to Tampa, Florida. The *Gloucester,* in the vicinity, obligingly picked up all hands safely after they had been in rowboats only an hour. On arrival at Harbor Island, the 12 men were checked out by customs authorities, who hurried from Corpus Christi, and examined by a doctor. Only then were they allowed to leave the supertanker. Land never looked better to rescued seamen.

Harbor Island is reached by a toll causeway (fee: $1 each way) stretching seven miles from the nearest mainland city, Aransas Pass. From the causeway approach, Humble's gigantic silver storage tanks loom on the horizon. Among them loiters a small flock of sheep, grazing deliberately.

Once past the friendly gatekeeper, you drive up to terminal headquarters

to meet the head man at Harbor Island. He is Superintendent Florian Gerbig, an oldtime pipe liner who had rather load crude oil than talk about it. He came to the island when it was built; has been its chief almost since the beginning.

Helped Load First Tanker

Superintendent Gerbig helped load the first tanker at Harbor Island in October of 1928. Before that, he was a crewman at the old Humble docks at Texas City. He retires on August 31—the 30th anniversary of the building of Harbor Island—with 38 years' service.

A modest man, Superintendent Gerbig pooh-poohs his part of the credit for 30 years of fast and safe tanker loading at Harbor Island. That credit, he insists, goes to the 47 Humble Pipe Line employees who make up the Harbor Island team. (Incidentally, that's about the same number of men required to run a modern supertanker.) Too, he will tell you of the terminal's high-capacity storage and loading equipment.

Oil storage at Harbor Island, Mr. Gerbig explains, consists of 21 tanks with a combined capacity of 1,759,000 barrels. This includes 18 crude oil tanks, three fuel oil tanks. Nine of these have floating roofs to curtail evaporation—vapors cannot form because the roofs float atop the liquid at all times.

Fuel oil is barged from Baytown refinery; five grades of crude oil are pumped from Ingleside, 14 miles away on the mainland and the site of a Humble refinery until 1945. Ingleside Station has a storage capacity of 3,300,000 barrels—Humble's largest crude oil tank farm. It pumps oil to Harbor Island through one 12-inch and two 10-inch lines at the rate of 9,000 barrels an hour.

The pump station at Harbor Island, which can pulse the oil aboard two tankers simultaneously at a peak rate of 55,000 barrels an hour, is located near the center of the island. With all pumps operating at once, you can actually see a tanker inch down into the water with the weight of the onrushing oil.

Delivery facilities include two T-head oil loading docks and one barge slip. The docks are designed to load supertankers to a maximum draft of 36 feet; the barge slip can load crude oil at the rate of 12,000 barrels an hour.

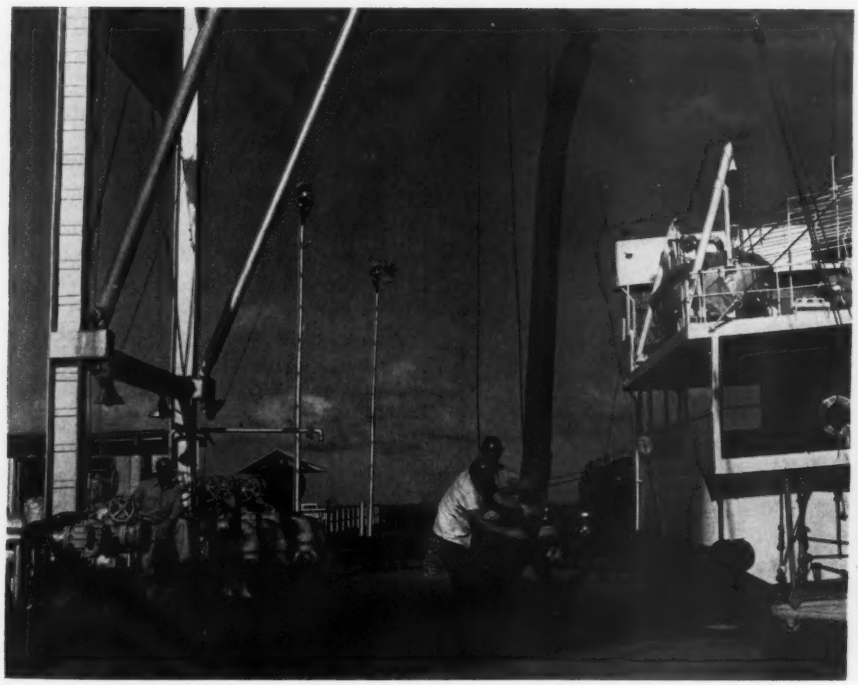
In an age when energy demands are skyrocketing, the men at Harbor Island have had a ringside seat. Through the years, they have seen more tankships and bigger tankships and speedier tankships come to be filled with crude oil.

Loading Crews Remain Ready

Some of them remember that when Harbor Island was built in 1927, only four American tankships were longer than 500 feet. By contrast, they know the *Esso Gettysburg,* recently loaded at Baytown, is one of two new supersupertankers of 715 feet length; it can float 318,000 barrels of oil. They have read that the American shipyards at Kure, Japan, launched the record-breaking *Universe Leader,* a tanker 855 feet long with a capacity of 620,000 barrels. They have heard talk of still more gargantuan tankships.

To the Humble Pipe Line men at Harbor Island Terminal, all this means that the world's citizens are using more petroleum than ever before. In turn, it means they will be called on to load more tankers, load larger tankers and load them faster—while maintaining their rigid standards of safety. When the tankers come, the men at Harbor Island must be prepared day or night, rain or shine, to "fill 'em up."

They are ready.



Loading completed, hoses are guided back to dock like domesticated boa constrictors; tanker now slumps low in water under weight of 202,000 barrels of West Texas crude.

Out to sea goes a supertanker only 12 hours after docking at Harbor Island.

Debris and wreckage strewn about in this oil producing area give some indication of the fury of the winds and waves in the hurricane's main path. Humble's properties were east of the main disturbance, but a variety of installations suffered minor damage.

Hurricane Audrey did only minor damage to Humble properties, but . . . . WEATHER

WHEN serious weather conditions are added to the normal risks which go with the search for oil in the offshore waters of the Gulf of Mexico, the oil industry's problems are multiplied.

This was dramatically emphasized late in June when Hurricane Audrey struck a paralyzing blow to a portion of the upper coast of Louisiana.

Although Humble had virtually no properties in the direct path of the storm, six districts on the eastern fringe of the disturbance suffered losses which total approximately $800,000. This loss estimate combines actual physical property damage, rig down time, payrolls, and evacuation costs.

Property damage in varying degrees was suffered in the Avery Island, Bayou Sale, Grand Isle, North Crowley, Paradis, and Port Sulphur districts. It included damage or loss of several small boats, barges, and houses; damage to roadways, warehouses, truck ramps, structures, storage tanks and separators, pipelines, power lines, electrical installations, and one well. The storm also deposited silt and debris in canals to the extent that dredging work had to be undertaken.

One of the more dramatic problems Humble production people had to cope with occurred at Weeks Island in the Avery Island District immediately after the storm. Here, high water crashed a dredge boat against a Humble well, the R. H. Goodrich No. 6, knocking off the wellhead and allowing the well to flow wide open. As soon as the storm subsided enough to allow work, crews moved in and capped the well without too much incident and without great loss of crude oil. Fortunately, the well did not catch on fire.

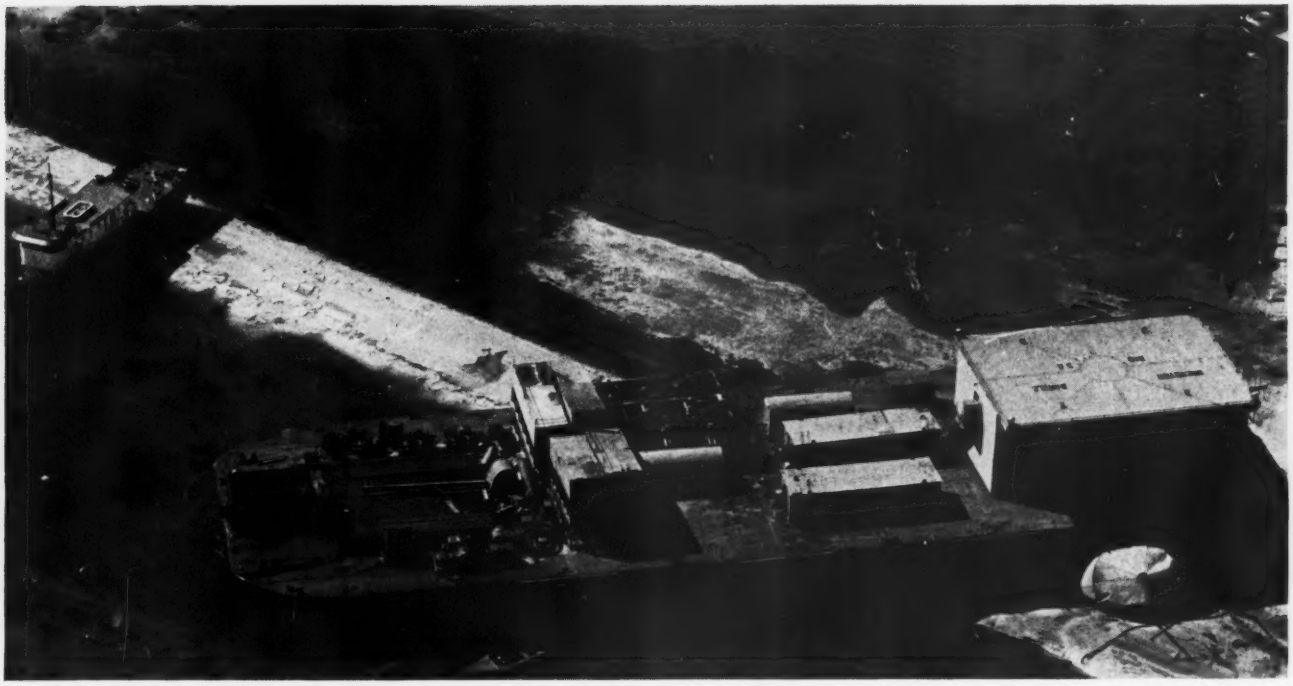
Even though weather forecasts indicated that the hurricane would strike west of most of Humble's offshore and onshore properties, the Company's established hurricane precautionary plan was set in motion in the Louisiana area well before the storm struck. Here's how the plan worked when Audrey was spotted out in the Gulf and was identified as a potentially serious disturbance:

Early Tuesday morning, June 25, the New Orleans division office received the first report from the A. H. Glenn weather advisory service, to which Humble subscribes. The report confirmed that the hurricane was definitely heading for the Louisiana coast. This intelligence was promptly relayed to all district offices with the advice that precautionary measures be undertaken promptly.

On drilling rigs in the Gulf and in

Like other oil companies operating in Louisiana, Humble joined in the rescue and disaster work in the area most severely stricken. Two large S-55 helicopters were made available for rescue work and a smaller helicopter was later made available for search assignments. Arrangements were also made to place two marsh buggies at the disposal of rehabilitation officials in the Cameron area.

A substantial contribution was made by Humble to the Red Cross disaster fund.



Small storage tank was crushed when this big work barge was beached on a waterfront road, along with a smaller boat. Most of Humble's losses were not in the form of properties destroyed but properties damaged to the extent that repair and rehabilitation costs mounted.

COMPOUNDS OFFSHORE RISKS

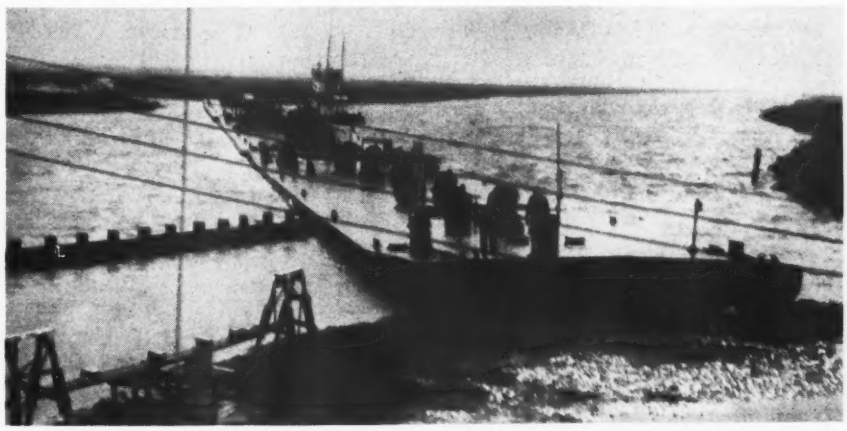
the marshes, tool pushers ordered drilling wells shut down by midnight Tuesday. Drill pipe pulled out of the holes was racked and lashed; blowout preventers were closed; and plants were shut down. Pumpers hurried to producing wells and shut them in.

On the tenders out in the Gulf, cargo was stored in the ships' holds, hatches were covered, and water-tight doors closed. Except for a few who remained behind to complete final details of preparing all equipment for the blow, the men were rushed to Grand Isle by helicopter.

By acting speedily on the early Tuesday morning advisory, the trained Grand Isle organization was able to evacuate all 600 people involved in offshore operations by midnight Tuesday. Upon arrival at Grand Isle those employees who live on the island prepared their homes for the blow and then moved inland with their families. Others who live on the mainland went to their homes, and in many cases moved farther inland.

If the weather advisory had indicated that the Grand Isle base was to be in the path of the disturbance, all helicopters would have been flown to distant bases. Because it was tracked to strike the coast appreciably west of Grand Isle, all helicopters which could be safely housed were tied down and closed up in the base hangar. Others were flown to safety at Mobile, Alabama, about 200 miles northeast.

As soon as the weather cleared and tidal waters receded, Humble crews returned to the area to assess damage and to begin the job of restoring all damaged facilities to working order. The job was undertaken philosophically; offshore employees recognize hurricanes and other weather problems as one more in a long line of costly risks which the oil industry faces in developing offshore oil reserves.



This oil barge (not Humble's) was torn loose and blown across Intracoastal Canal. Many canals in storm area were so filled with debris and silt, dredging was required.

Sulphur IN THE

FREEPORT TO MINE HUMBLE'S OFFSHORE SULPHUR DEPOSIT

THE first completely offshore sulphur mining operation in history will be undertaken by Freeport Sulphur Company at a deposit discovered in the Gulf of Mexico by Humble Oil & Refining Company. Approval of the assignment of seven leases in the Gulf of Mexico by Humble to Freeport Sulphur Company came from the Department of Interior on Friday, June 12.

The deposit, located off Louisiana in 45 feet of water six miles from the nearest land, represents a "major new source of sulphur," according to a joint announcement by the two companies.

Under a contract signed by the two companies in September, 1956, Freeport will design, install, and operate a mining plant to produce sulphur by the Frasch hot water process. Construction will begin by the latter part of 1958 and is expected to take two years to complete.

"The deposit, known as Grand Isle Block 18, was discovered by Humble in the course of offshore oil exploration," the announcement stated. "It ranks among the most important sulphur discoveries of recent years."

The sulphur was found approximately 1700 feet below the floor of the Gulf in the cap rock of a salt dome, a geological formation commonly found in the Texas and Louisiana Gulf Coastal area.

First Mining in Open Waters

"Grand Isle will be the first sulphur mining operation to be conducted in the open waters of the Gulf of Mexico," the announcement continued. "It will be a new and novel undertaking, but one for which Freeport is especially qualified because of its experience in mining sulphur at marshland and partially submerged locations.

"Freeport has developed and successfully operated three sulphur mines in the coastal marshes. Two of the mining plants were erected on 75- to 95-foot piling, and the third was built on a barge, floated to the site, and sunk in place. The company also pioneered the use of seawater in the Frasch process and marine transportation of sulphur in molten form, innovations which will greatly facilitate offshore operation."

Signing agreement in 1956 were Langbourne M. Williams, president of Freeport, and Humble President Hines H. Baker, since retired.

The contract also involves sulphur rights in two other offshore domes, known as Grand Isle Block 16 and West Delta Block 30, the announcement stated. Block 16, where sulphur has been discovered by Humble, is about five miles west of the Block 18 deposit. Block 30, where Freeport will continue prospecting begun by Humble, is 12 miles to the east.

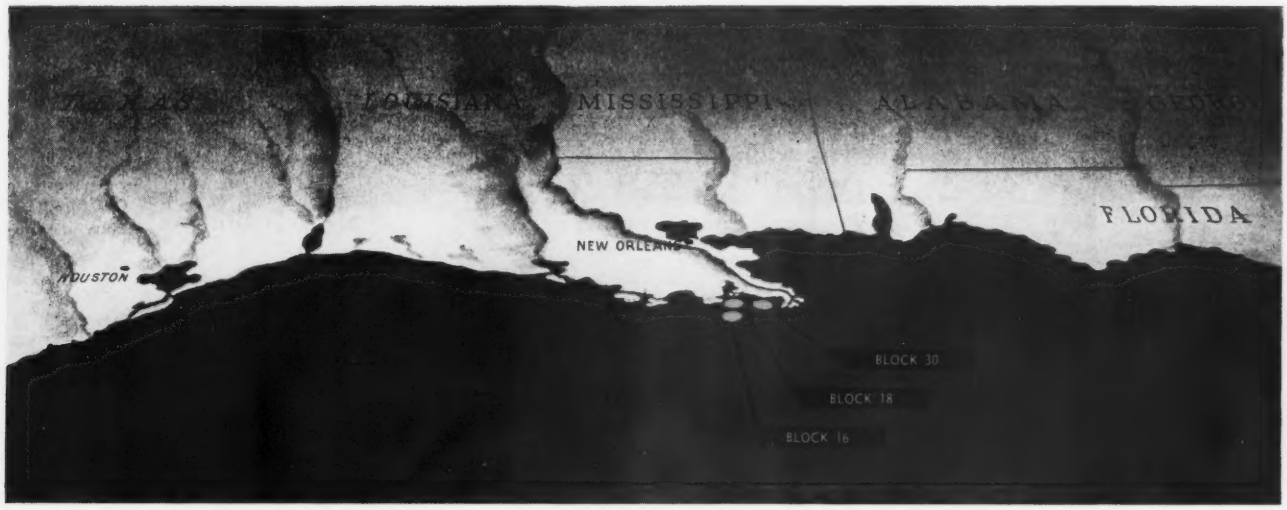
The sulphur rights are held by Humble under leases originally executed by the State of Louisiana and later confirmed by the United States government pursuant to the provisions of the Outer Continental Shelf Land Act, it was stated.

Frasch Process to be Used

Production of sulphur from beneath the floor of the Gulf will be entirely different from production of oil. The Frasch process, whereby super-heated water must be fed continuously into the formation to melt the sulphur which in molten form is forced to the surface through wells, requires a heating plant of great capacity and weight. This plant and all other installations will have to be built on a tall steel structure, out of reach of storm waves. The structure will be the largest of any of the permanent structures in the Gulf of Mexico.

In absence of storage space, insulated barges will shuttle the sulphur in molten form to Port Sulphur, storage and shipping point about 25 miles away. On the return trip, the barges will haul fresh water necessary for boiler make-up and auxiliary services. The Gulf itself, however, will supply the millions of gallons of water required daily for injection into the wells at high temperature.

IE GULF OF MEXICO



Yellow ovals mark salt domes where Humble crews drilled, discovered world's first offshore sulphur deposits. Big find was six miles from land at Grand Isle Block 18. Nearby is original discovery Block 16; West Delta Block 30 is 12 miles to east.

THE STORY BEHIND THE DISCOVERY

IT BEGAN just like any other offshore coring job. While the Gulf breeze wafted in across the drilling barge, the husky Humble driller attached the core barrel and diamond bit to the business end of his drill string. Down, down, down through the the casing it went, back into the hole. Turning. Cutting. Grinding. Then came the return trip—the derrick man, aloft with the seagulls, racking the long strings of pipe.

Before the core barrel had disgorged half its cargo, the geologist knew that Humble's fourth drilling effort in the Gulf of Mexico had turned up something different. Breaking the four-foot core column with his hammer, he held up the chalky gray limestone to the afternoon sun. Those yellow flecks and streaks—he had seen them before in cores, on inland jobs around salt domes. He identified them, with subdued enthusiasm, in a word: "Sulphur."

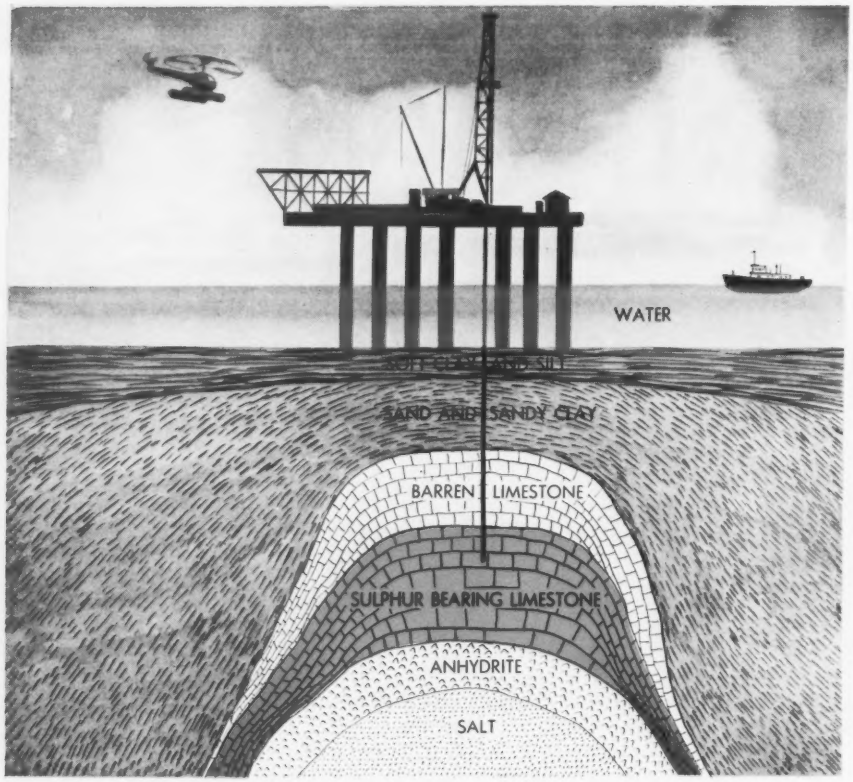
Had he foreseen the significance of this 1948 find, perhaps the geologist would have been more than mildly excited. For subsequent study of an adjacent sulphur strike six miles offshore at Grand Isle, Louisiana, has shown it to be an important find. It should, in fact, rank as one of the world's top five sulphur discoveries.

The finding of sulphur on the Continental Shelf was something of a first. The Biblical brimstone which reputedly fuels the fires of Hades is at home just about any place (in shallow earth, deep in the earth over dry-land salt domes, volcanoes, mineral springs, crude petroleum, meteorites from outer space). But now, Humble exploration teams had tracked sulphur to still another habitat—beneath the ocean's floor.

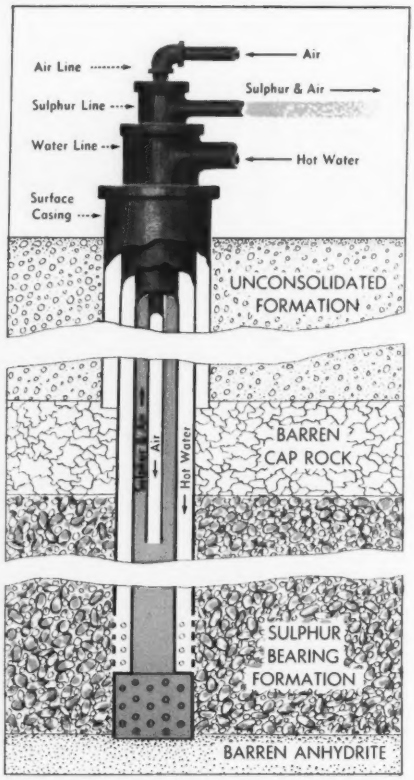
Oil men traditionally have led the way in finding sulphur. Drillers for eastern companies found the yellow element in their bits as early as 1867 in the Calcasieu Parish of Louisiana. But the quicksand of the marshy swamps proved too treacherous when they tried to mine it by conventional methods. French, Austrian, and American companies failed in quick order —and not without loss of life.

In December of 1894, a young German scientist for the Standard Oil Company in Cleveland accomplished the impossible. Within almost a mile of original discoveries, Herman Frasch struck and produced sulphur by a revolutionary new hot water method (See diagram and "Sulphur: What About It?") to become the father of the American sulphur industry.

It is small wonder, then, that Humble geophysicists and geologists exploring the buried salt domes under Grand Isle Blocks 16 and 18 off the Louisiana coast considered the possibility of sulphur in the cap rocks. Underwater



Artist's cutaway conception of offshore Block 18 salt dome shows drilling through hard, limestone cap rock into golden-colored sulphur zone. Sulphur occurs here at depth of 1,700 feet.



Frasch process utilizes hot water to melt sulphur, then air to force it to surface.

seismic explosions and use of gravity meters led to an oil and sulphur test well near the center of the salt dome on Block 18. The result was double-barreled. The well produced a limited quantity of oil, and coring showed rich, rhombic crystals of sulphur buried in the limestone.

Later, through arrangements with the U. S. Department of Interior, Humble drilled sulphur test wells on the two blocks and on West Delta Block 30—some 12 miles to the east.

Test Wells Drilled

Here the portable DeLong drilling barge used for offshore oil well drilling swung into action. Out into 45 feet of water the floating rig went, sinking its supporting caissons into the ocean floor and then jacking itself up 40 feet above water level on 12 giant steel legs. Once the platform was in place, the seagoing sulphur men set to work.

The drilling of the test wells told a great deal. Sulphur was encountered in depths ranging from 1,700 to 2,000 feet and the underground brimstone belt seemed to cover several hundred acres. Block 18 proved the biggest find —three times larger than Block 16, the original discovery. Although the cap rock at Block 30 has not been explored completely, shows of sulphur have been found there.

Late in 1956, however, Humble officials announced a mining agreement with Freeport Sulphur Company under terms listed in the foregoing announcement story. The decision came only after exhaustive study. The most adverse factor facing Humble engineers and economists was that drilling offshore sulphur wells, like drilling offshore oil wells, is about five times as expensive as on dry land.

Other important considerations were: (1) how to supply the vast amounts of water—and the fuel for heating it—that the Frasch sulphur process requires; (2) how to transport the sulphur from offshore wells to land; (3) how to load the sulphur into ships for the world market.

Sulphur, the cheapest basic element per pound, is often—and correctly—called the "most versatile chemical substance known to man." During the Eighteenth Century, Cagliostro told Marie Antoinette: "Let me burn enough sulphur and I will turn any base metal into gold." The French alchemist and wizard was wrong, of course; but he must have had some inkling of the uses that science someday would make of the "stone that burns."

An Indispensable Element

Sulphur is necessary. We couldn't exist without it. It plays an important role in our food, our water, our shelter, our clothing, our air—those things absolutely essential to life. This element is a basic chemical substance making possible or improving thousands of products—among them gasoline, rubber, rayon, paints, dyes, fats, films, tin cans, iron and steel, medicine, explosives, fertilizer, pesticides, and plastics. The biggest use of all is in making sulphuric acid for industry. It is part of this magazine's paper and ink. You use about 70 pounds a year, in one form or another.

Sulphur is in demand. Until it was mined in Louisiana's Bayou Chou-

pique in 1894, the little island of Sicily (off the booted toe of Italy) enjoyed a virtual world-wide monopoly. Since that time, the lands bordering the Gulf Coast have become the world's most important single source of sulphur. Annual world consumption has soared to 7 million tons, but demand has usually equaled, sometimes surpassed, production. Current domestic price: $25-$28 a ton.

Sulphur's long-range future appears bright. Today, thanks to abundant new supplies from large U. S. and Mexico mining developments, sulphur is in slightly excess supply. In addition, sulphur is being recovered from natural gas and factory waste gases, and obtained from pyrites (fool's gold). But buried deposits, mined by the Frasch process, generally are cheapest, purest, simplest to recover. Consequently, the world's first offshore sulphur eventually will find its place in the markets.

Even the pioneering Dr. Frasch would be astounded by some of the engineering problems of producing offshore sulphur and getting it to market. And Dr. Frasch, remember, was a past master at astonishment himself. Stroking his Van Dyke beard, he liked to recall how colleagues scoffed at his process—one even vowing to eat every ounce of sulphur he pumped from the ground.

"A fair indication of public opinion," said Frasch in his speech accepting the AIME Perkins medal in 1913, "is the remark of a mail boy who drove me over to the railroad the morning after our first pumping. 'Well, you pumped sulphur, sure; but nobody believed it but the old carpenter, and they say he's half crazy.' "

Sulphur: What About It?

How is sulphur formed?

No one is absolutely sure. But as for Gulf Coast sulphur, most of it occurs over the salt dome, that petroleum-trapping delight of Gulf Coast oil men. One theory is that as the salt moved upward, surface water dissolved it, and certain residue minerals accumulated from the salt to form a hard cap rock, or as it is called in Germany, a "hat." Due to a chemical change of these residue minerals, sulphur crystals resulted.

The agent that triggered the transformation is a phantom that provokes much debate. Some say bacteria: this is the most popular theory. Others think high temperatures (such as exist deep in the earth) gave birth to the sulphur. Still a completely different theory holds that the sulphur arose, with the salt, from a deep-seated source.

Do all salt dome cap rocks hold sulphur?

No. Less than ten per cent. And geologists don't know why one does, another doesn't. About 260 salt domes are known to exist in Texas and Louisiana alone. These structures also are found in Mexico, Russia, Germany, Rumania, Persia (Iran), and North Africa. Only 19 of the U. S. domes, all on the lands bordering the Gulf Coast, have been mined; eight of these have been exhausted.

Are Gulf Coast salt domes more conducive to sulphur?

Apparently. Texas' 36 shallow domes (less than 5,000 feet in depth) have included 13 with enough sulphur profitable to produce. Louisiana's 37 shallow domes have included 11 with commercial sulphur deposits. Still, only 11 of the commercially productive domes in the U. S. are being mined at present.

What about offshore sulphur frequency?

Geologists guess it to be about the same as inland. Two of the 11 shallow domes off the Louisiana shore (both Humble discoveries) contain sizable deposits. As for offshore Texas, one shallow dome has shown no outstanding sulphur deposit; two more are now being drilled.

Where is the world's largest known sulphur deposit?

The Boling mine at Newgulf, about 75 miles southwest of Houston. In 23 years, the single dome has yielded nearly 50 million long tons. The second largest producer is the Lake Washington or Grande Ecaille, Louisiana, dome. Three other deposits promise to be one-fourth to one-third as rich as Boling: (1) the Mexican mine at Jaltipan, (2) Garden Bay, Louisiana, and (3) the Humble discovery at Block 18.

Is the Frasch production process complicated?

Under normal conditions, on dry land, no. Herman Frasch was able to extract almost pure brimstone from the earth by taking advantage of two sulphur properties: (1) Its low melting point—about 240° F. (2) Its weight—almost twice that of water.

Superheated water (about 320° F.) is forced through wells into the cap rock containing the deposit. As the sulphur melts, it flows to form a pool at the bottom of the wells. The molten sulphur then is pumped above ground by compressed air. Through steam-heated lines, it is then pumped to storage vats, where it cools into the familiar chalky, yellow substance. In recent years, sulphur in molten state has been moved by insulated barges from Texas and Louisiana mines to storage points and to consumers.

How goes Golden Esso Extra?

A fuel of the future, Golden Esso Extra provides better engine performance for an ever-widening range of modern automobiles. Introduced as Humble's top grade in 1956, it has gained a stable position alongside Esso Extra and Humble Motor Fuel.

HUMBLE dealers and agents took good-natured ribbing a year ago when yawning pits began to appear on their premises. Some customers asked about the depth at which buried treasure was expected; others speculated on the practicality of swimming pools at service stations; still others looked inquisitive but said nothing.

These excavations were the first external evidence that Humble had something special up its sleeve for the customer. Packaged in a gilded gasoline pump, the surprise turned out to be Golden Esso Extra, a new premium *over* premium gasoline that celebrated its first birthday on June 20.

After one year, how goes Golden Esso Extra? Has it caught on with motoring Texans? Is it affording them better automotive performance? And is it destined for still wider use?

Golden Esso Extra was introduced on June 20, 1956, in five key cities. Today, it is being marketed throughout Texas east of the Pecos River. In the past year, Golden Esso Extra has staunchly established itself alongside two other great Humble fuels—Esso Extra and Humble Motor Fuel. It has captured a respectable percentage of the total sales volume in Humble service stations and it is performing precisely as advertised—better, in some cases.

Motorists who drive cars with high compression ratio engines tell Humble dealers they like the better performance and operating economy; they say these more than offset the small additional cost. More mechanical-minded drivers find that Golden Esso Extra prevents knock, pre-ignition, and in summer, vapor lock.

Since Golden Esso Extra was introduced, Texans themselves have taught Humble something about its own extraordinary gasoline: that more cars need it than was first thought. This is no gasoline exclusively for the long, sleek road yachts. Customers say it puts pep in certain of their medium-aged, low-priced cars as well. Golden Esso Extra is *now* recommended if

One year old, Humble's new premium-over-premium gasoline is gaining friends among motoring Texans by living up to billing as 'world's finest'

any one of these situations applies to your car: (1) Knocks on premium gasoline. (2) Is air-conditioned. (3) Has more than one carburetor or power pack. (4) Has an engine with 200 or more horsepower. (5) Has a compression ratio of 9 to 1 or higher.

Owners of less conventional types of motor vehicles ask for Golden Esso, too—probably with tongue in cheek. These include pilots of antiquated autos, motor scooters, and, in some cases, power-drive lawn mowers. Humble dealers don't recommend Golden Esso Extra for such, but they sell it anyway, shake their heads, grin tolerantly, and say "more power to you."

More power—through increased horsepower and compression ratio—has been in demand in recent years. Forty years ago, when the Humble company was organized, the average automobile engine housed four cylinders with a horsepower apiece. The average horsepower of 1957's eight-cylinder models is about 250; some carry more than 300. Compression ratios, which as little as two decades ago were 6 to 1, now average 9 to 1. By 1960, it is predicted the average may be as high as 12 to 1.

Soaring horsepower and compression ratios point up the need for an ultra-high performance fuel like Golden Esso Extra, whose octane number is well above that of conventional premium fuels. The first gasoline refined by Humble at Baytown in 1921 probably hovered around 50 octane. By contrast, the average octane number, industry-wide, of today's premium gasolines is 97. And before a May meeting of the American Petroleum Institute, a Humble scientist predicted that high-performance cars of 1960 will need a motor fuel 10 to 12 octane numbers higher than current levels.

Thus, Golden Esso Extra seems headed toward still bigger things. While only eight per cent of 1955 models and 19 per cent of 1956 models require a fuel of Golden Esso Extra's quality, it is estimated that 45 per cent of 1957 models need it. That percentage will continue to rise in the coming 1958 automobiles.

The story of Golden Esso Extra's development and introduction is typical of Humble's far-sighted planning to stay ahead of customer needs. As early as 1949, Humble research scientists were doggedly hunting the recipe for a new and more powerful gasoline. There was good reason: the automobile industry was producing more powerful cars with a wide array of power accessories. This meant that the American motorist needed a higher grade fuel to get maximum performance from his new car.

Two avenues were open to the research scientists. They could boost the octane number of Esso Extra—or develop a new gasoline to give Humble three grades.

Under a two-grade system, Humble customers with intermediate quality fuel requirements (cars two to four years old) would have been faced with a tough choice. They could use Humble Motor Fuel and suffer a performance loss—or they could buy up-graded Esso Extra and pay for a premium fuel their cars simply did not need. This corresponds roughly to a man's being offered the choice between a single apple and a whole bushel, when he actually wants a dozen.

The three-grade system, somewhat a revolutionary concept, answered the ever-widening range of power requirements. Based on the feeling that no motorist should have to pay for quality he did not need, it seemed to be in the best interests of the general public, gasoline buyers, and the petroleum industry. Golden Esso Extra was born.

Everyone, it seems, is happy about Golden Esso Extra. Auto makers are quietly enthusiastic about a fuel that allows them further engine advances. Humble service station operators are pleased to see their total premium sales move up. The Humble company itself was naturally proud to chalk up another first in Texas by placing on the market the world's finest gasoline.

And the man behind the wheel reaps benefits, too—with a fuel of the future like Golden Esso Extra, he gets all the performance they built into his engine at the factory.

HUMBLE'S FAMILY OF THREE

Today's automobiles embody a wider range of power requirements than ever before. That's why Humble offers *three grades* of gasoline. With three grades to choose from, the customer pays *only* for the quality his car requires.

Humble Motor Fuel—This is a gasoline for motorists whose cars perform well on regular grade gasoline. It sets the pace for performance and mileage in the *regular* classification; and it contains a special solvent oil to help keep engines clean.

Esso Extra—There are hundreds of thousands of Texas automobiles that give peak performance on this premium gasoline. It's No. 1 in Texas, first in sales among premium gasolines because it's first in quality. It is still the *best* for many motorists.

Golden Esso Extra—If your car has an engine with a very high compression ratio, or if it tends to ping or knock on premium gasoline, you need this premium-over-premium motor fuel. You can read about this newest product of Humble's gasoline research—now one year old—in the article above.

Report Shows First Half Operations Higher

The following report on Company operations for the first half of 1957 was mailed to shareholders on August 9:

A STEADILY rising investment in facilities operated by the Company, higher operating volumes, and increased realization for crude oil and products combined to raise Humble's net income in the first half of 1957 to $107,788,500, a gain of $15,428,000 over the same period last year. On the basis of the new shares outstanding after the stock split effective May 21, 1957, the net income was $1.50 a share and dividends were $0.65 a share in the first half year.

Operations and earnings in the first six months benefited from unusual export and domestic demands while the Suez Canal was closed. Reopening of the Canal was followed quickly by a decline in exports and a record level of crude oil imports to the United States. The resulting sharp decrease in demand for domestic crude oil made necessary drastic curtailment of production, particularly in Texas and Louisiana where Humble has most of its producing operations. Because of this adverse development and recent further increases in costs of labor and materials, it is anticipated that Humble's production and net income during the remainder of the year will be less than in the first half, although results for the full year should still show a gain over 1956.

It is essential that the upward trend in crude oil imports be checked in order that the domestic industry may have market outlets expanding sufficiently to encourage discovery and development of the reserves needed for national security and for future requirements. A Cabinet Committee has again concluded that rising crude oil imports are a threat to national security and has recommended a voluntary plan approved by the President for limitation of such imports. The plan does not correct previous excesses over the standards recommended in 1955, and allows for a substantial increase in imports over 1956. If it is observed, however, it will keep imports from increasing an additional 200,000 barrels daily as had been planned by importing companies. It remains to be seen whether the limitations recommended will be observed and whether they will be sufficient to encourage domestic producers to expand exploration and drilling.

Humble's capital expenditures in the first six months were $109,328,400, slightly higher than in the preceding six months, and $31,122,500 above the amount in the corresponding period of 1956. In addition to capital expenditures, exploration expenses charged against current income were $57,024,600. The completion of 41 offshore wells and construction on several major new units at the Baytown Refinery contributed to the high level of capital expenditures. In the first half year, Humble completed 320 producing wells and 110 dry holes.

Recent developments of interest are the decision to explore for oil in Alaska and approval of Humble's arrangements for the mining of sulphur at Grand Isle. Humble has entered into an agreement with Shell Oil Company under which it will acquire a half-interest in a substantial block of acreage in Alaska by drilling several wildcat wells. Drilling of the first well in Alaska is scheduled to begin in September. On July 12, the Secretary of the Interior approved the assignment by Humble to Freeport Sulphur Company of the rights to mine sulphur from the offshore deposit discovered by Humble at Grand Isle, Louisiana. Freeport will begin construction before November 1, 1958, of a plant with sufficient capacity to mine a million tons a year if favorable thermal efficiency is achieved. Humble is to receive approximately 50 per cent of the profit from operation of the plant.

Sales of gas in interstate commerce continue to be hampered by the present status of Federal regulation over such sales. Congress has under consideration a bill which would provide more reasonable controls without subjecting gas producers to utility-type regulation wholly unsuited to the business of finding and producing gas because of the high risks involved and the difficulty of ascertaining costs for gas separately from oil. Enactment of this bill is necessary if gas consumers in non-producing areas are to enjoy adequate future supplies to meet their demands. The rapidly expanding intrastate market for natural gas, however, makes possible some additional sales at better prices.

	1957	1956	
	First Half[1]	First Half	Year
FINANCIAL DATA			
Total Operating Revenue	**$667,705,900**	$590,803,500	$1,189,031,000
Net Income	**107,788,500**	92,360,500	178,961,100
Taxes (Including Fed. Income Taxes)	**49,292,000**	44,319,800	79,714,700
Dividends Paid	**46,628,500**	43,030,900	86,072,400
Capital Expenditures	**109,328,400**	78,205,900	183,908,000
Exploration Expenses Charged Currently Against Income:			
Total	**57,024,600**	46,747,900	98,089,200
Dry Holes	**28,780,700**	22,810,700	48,085,400
Net Income Per Share[2]	**$1.50**	$1.29	$2.49
Dividends Per Share[2]	**$ .65**	$ .60	$1.20
OPERATING VOLUMES— Barrels Daily			
Net Crude Oil Production	**392,400**	373,800	371,000
Crude Oil Refined	**243,600**	267,200	261,800
Trunk Line Deliveries	**734,100**	698,400	699,700
WELLS DRILLED BY HUMBLE			
Producing	**320**	368	692
Dry	**110**	98	213

[1] *Subject to change by final audit for the year.*
[2] *After the two-for-one stock split on May 21, 1957.*

All-weather, 18-mile road network that meanders through steep, rugged foothills of the Sierra Nevada range, is only one of the many man-made improvements necessary before oil could be produced in Humble's Castaic Junction Field near Los Angeles.

OIL IN THE MOUNTAINS

Rugged Castaic Junction, Humble's first big discovery in California, served the Company as a prototype for the production of oil in mountain country

"HOW in the world can anyone ever produce oil in country like this?" a flatland visitor to Humble's Castaic Junction Field once asked.

And at first glance, it seemed he had a point.

Sharp, craggy, treeless foothills cut by deep ravines fell away through the haze to the flat, open Santa Clara River bottom. To the north rose more hills and canyons leading the way to the Sierra Nevada.

Seven years ago, before the coming of the drilling rig, it looked wild, rugged, perhaps the ideal location for Hollywood and Roy Rogers to grind out another western movie.

Castaic Junction still retains that rugged beauty today, but with certain changes. Christmas trees marking 56 producing oil and gas wells now punctuate the landscape. Steel storage tanks gleam here and there on the slopes. Eighteen miles of surfaced, all-weather road meander up and down the steep grades like a scenic drive in a state park.

More than 6.5 million barrels of oil and 12 billion cubic feet of gas have been taken out of the field so far. A modern gas pressure maintenance plant sits atop one of the bluffs to help produce the sluggish oil in the most efficient manner possible.

Any visitor to this mountainous oil field—Humble's first big discovery in California—would be surprised at the progress that has been made in seven short years. For it is evident that Castaic Junction didn't come easily or inexpensively. Problems, it seemed, loomed at every turn of the way. The discovery and development of the field is a story of oilmen against the elements, oilmen against geography.

Never before had Humble's geological and production organizations been confronted with the development of such a rugged area. Castaic Junction, for this reason, served the Company as a guinea pig, so to speak, a pilot plant for the development and production of oil in mountainous terrain.

The story of Castaic's discovery dates back to 1948 when Humble geologists first moved into the Santa Clara Val-

Workover rig is being torn down and moved off an ailing Castaic Junction well, temporarily shut in because of a casing leak. Derrick is divided into two sections, carefully loaded onto trucks, and then moved out over all-weather, hard-surfaced road network.

ley and set up housekeeping near Castaic Junction, a small community 32 miles northeast of Los Angeles. Oil wasn't new to the area. One of the first commercial oil fields in California, in fact, was producing in 1875 a few miles away. Subsequent discoveries opened up the Newhall-Potrero field to the south of the present location of Castaic Junction and the Del Valle field to the west. Wells in these fields, however, were nearing the edges of production and it appeared that the reservoirs did not have extensions. At Del Valle, a step-out dry hole toward Castaic Junction a year before Humble arrived on the scene had stopped leasing and wildcat drilling in that direction.

Humble geologists, however, felt that due to faulting there might be other productive areas in the vicinity. They believed that a separation existed between the main anticline of the nearby Del Valle and the nose-like extension of the structure under the Humble leases.

To give their theories a try, late in 1949 geologists picked a dry, sandy spot at the intersection of the dry beds of Castaic Creek and the Santa Clara River.

The new wildcat—Newhall Land & Farming No. 1—started out as do most wildcats—with a dash of optimism. But by 9,500 feet spirits began to cool. Instead of hitting the anticipated sand objectives and oil horizons, the drill bit had found 1,500 feet of shale. To all intents, this was the finale. Shale probably would continue for thousands of expensive feet, then end in a dry hole.

But Humble geologists bowed their necks and kept right on going, straight down through this formation. After 2,900 feet of shale, the situation looked even worse. Less bold geologists might have thrown in the towel at this point. But then, just as suddenly as the bit had entered the shale, it came out and soon drilled into sands and then into a gas condensate reservoir.

The well discovered a prolific gas condensate reservoir, California's first at this depth of 12,000 feet and Humble's first big field on the West Coast. And better things were still to come.

Humble geologists didn't know it at the time, but this newly discovered reservoir (Zone 21, as it was called) was only one of three in the Castaic Junction Field. A half mile step-out on Newhall Land & Farming No. 3 discovered about 100 feet of oil sand at 10,000 feet (Zone 10). The sixth well discovered still another excellent oil reservoir (Zone 15) at 11,000 feet. Thus Castaic Junction Field had one gas and two oil producing zones.

These developments changed Castaic Junction from a *nice* find to a *major* discovery—the largest by the oil industry in California that year.

The field today is three and one-

half miles long, one mile wide and covers about four sections of land—90 per cent of which is covered by rangy foothills 1,500 to 2,500 feet high. Humble's three leases cover the entire field.

Since the discovery well was completed, drilling in the field has been continuous, generally on a two or three-rig development program. Humble now has drilled 61 wells, including 56 successful oil or gas wells and five dry holes. Six wells are dually completed—making a total of 62 completions in the field. The drilling program now has been reduced to one rig, which is currently on a deep well along the northeast edge of the field.

But discovering Castaic Junction Field was only part of the story. Humble production men soon found that producing the oil in this terrain was going to be equally tricky. Two of the toughest problems concerned roads and rig locations.

Locations had to be hewed out of the steep hillsides and roads built to connect these precarious spots to supply centers.

Surveyors, civil engineers, production geologists and bulldozer operators, wearing boots to protect themselves from rattlesnakes, moved into the hills and began work on a road network almost as soon as the discovery was announced. The steepness of these early-day trails—with sheer 200 and 300-foot dropoffs—soon had drilling crews matching coins to see who would get the "inside seats" on the trucks that strained up the inclines.

In January, 1950, roadbuilders learned they had an unusual erosion problem on their hands. A three-day downpour sent water cascading off the hillsides, making shambles of one section of roadway. Water cut a swath eight feet deep and six feet wide through the surface at one point. The crew on one location had to evacuate on foot and one well was shut in for a week.

And besides the erosion problem, it was found that gravel surfacing alone would not support heavy traffic needed for continuous drilling operations. When the gravel became wet, trucks could not climb the steep slippery grades.

"We found out quick enough that we had to protect our road dollars by making a larger initial investment," one civil engineer pointed out.

Castaic Junction compressor plant is one of the highest pressure gas injection plants known in the world. It can inject 22.5 million cubic feet per day at 5,000 pounds per square inch.

Temperature control is adjusted on heaters to keep flow lines clear of moisture, ice. Lines carrying ultra-high pressure gas to injection wells will freeze if not heated.

Another Castaic Junction field well is drilled on open space in Santa Clara Valley. Soon after picture was taken, well was brought in as the 57th producer in field. Castaic already has yielded more than 6.5 million barrels of oil and 12 billion cubic feet of gas.

Roads had to be passable the year around, and this meant hard surfacing them.

The road problem didn't limit itself to the mountains. One section of the field underlies the Santa Clara River bottom and low water crossings were washed away with each heavy rain. Here, engineers handled the problem differently. The crossings were so long they felt it would be cheaper to rebuild the roads after each flood than try to construct a permanent type bridge.

The one well in the river bottom, however, did have to be protected from floating logs or other heavy objects which roared through the area during floods. This was accomplished through reinforcing the sand bar on which the well was drilled by driving nineteen 30-foot pilings around it and pouring concrete on top. For further protection, a triangular metal screen guard was placed around the wellhead assembly.

The force of the flood was so great during one downpour that an entire row of cottonwood trees with trunks three feet thick was uprooted and floated away and a 1,000-barrel steel tank was washed into the riverbed and buried.

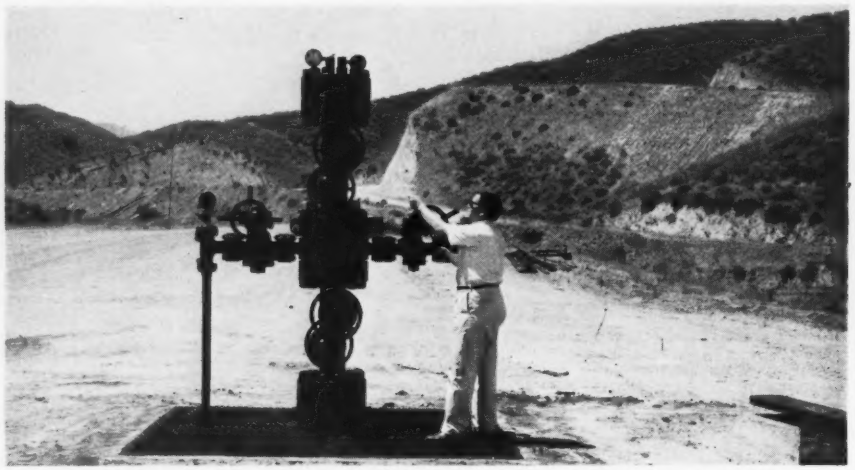
Although road problems were the most critical in this mountain operation, rig site construction and final cleanup costs also stood out in the expense column.

To prevent excessive location costs, the district civil engineer coordinated his work closely with the production geologist, for well spacing and terrain went hand in hand towards determining excavation costs.

Another big problem at Castaic Junction was that of pressure maintenance. While development of the field was still in progress, reservoir engineers noticed that the bottom hole pressure of the oil wells in Zone 10 began a rapid decline and a large number of wells were ceasing to flow. Like a stale bottle of soda pop, the reservoir was losing its fizz.

Humble petroleum engineers knew they would either have to make a large investment for artificial lift as well as face loss of ultimate recovery—or inaugurate a secondary recovery program by pumping salt water or gas under high pressure back into the reservoir to supply the necessary energy to lift the oil to the surface.

After careful studies, gas injection was selected as the best means of maintaining pressure and improving ultimate recovery. Under the plan, casinghead gas from Zone 10 and Zone 15 and gas condensate well gas from Zone 21 would be compressed and forced



Valve is opened on injection well to send compressed gas surging into subsurface reservoir. Well was originally drilled for oil, then dually completed for gas pressuring.

back into Zone 10. The oil in Zone 10 would mix with the injected high pressure gas and flow to the surface of its own accord.

The first compressor plant, put into service in 1954, began injecting 10 million cubic feet of gas per day into Zone 10 at 4,650 pounds-per-square-inch pressure. This made it one of the highest pressure gas injection plants known in the world. Gas pressure had to be very high because of the great depth and high reservoir pressure, and because the formation is not very permeable and the oil so thick.

Increases in bottom hole pressures of producing wells were noted soon after the injection started and as the pressure gradually increased, some of the lagging wells once again began to flow.

In 1956, the compressor was supercharged to permit the compression and injecting of still larger volumes of casinghead gas—up to 11 million cubic feet per day. This spring, a second compressor was added which doubled the capacity to 22.5 million cubic feet per day for Zone 10 injection.

Still another compressor will go into operation this fall. The new addition will cycle the gas (Zone 21) condensate reservoir taking out the liquid condensate and injecting lean gas back into the zone. It is designed to obtain maximum recovery and economic yield of the condensate, and to save the gas for additional reservoir pressure maintenance to attain maximum oil recovery from Zone 10. This new plant will have a designed pressure of 6,500 pounds per square inch with a capacity of five million cubic feet per day.

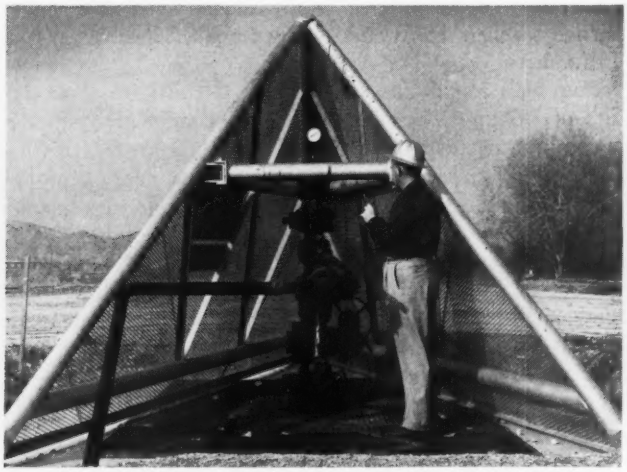
Gooey sample of Zone 10 crude oil is taken by district petroleum engineer Gene Thompson for shakeout, salt water content test. Heavy oil from this zone is similar to asphalt.

And in the future, still another compressor plant may be geared into operation. A study is now being made of Zone 15—which produces a lighter weight oil from a more porous formation—to see if a gas injection program is needed there to prevent shrinkage of the gas cap and increase oil recovery.

As a result of these repressuring efforts, ultimate oil recovery from the total field may be doubled or even tripled.

Sometime this year or next, the clang of drill pipe and the groan of a turntable will ring out across one of Castaic Junction's sandy hillsides for the last time. For the foreseeable future, development of the field will be completed and the curtain rung down on almost a decade of exploration and drilling activity.

Castaic Junction long will be remembered by Humble's California Area group, for it was a tough field to find and an even tougher one to develop. But these men learned long ago that oil is where you find it. They also learned that where you find it, there also you must produce it—whether it's beneath the swamps, under the seas, or in the mountains.



River-bottom well head assembly is protected from flood debris by triangular screen guard. Site is reinforced with steel, concrete.

Low water crossing over the Santa Clara River is washed away with each big rain. Engineers rebuild it rather than construct bridge.

Humble To Build King Ranch Gas Plant In Southwest Texas

ONE of the world's largest gas processing and cycling plants will be built by Humble Oil & Refining Company in Southwest Texas near Kingsville.

Construction on the new installation, to be known as the King Ranch Gas Plant, should begin in mid-summer, 1958, and will require about two years to complete. Total investment of the entire project may approximate $75 million.

Location of the plant will be in Kleberg County adjacent to the Company's present Seeligson Compressor Plant. The site is approximately 15 miles southwest of Kingsville, just inside the Kleberg County line.

When completed, the plant is expected to have a processing capacity of approximately 750 million cubic feet of gas per day. It will be designed to recover approximately 25,000 barrels per day of regular gasoline-plant liquid products consisting primarily of propane, butanes, and a mixture of natural gasoline and heavier hydrocarbon liquids.

The new King Ranch Gas Plant will process gas to be used for cycling and pressure maintenance operations and to supply industrial customers. Humble's existing Calallen Gas Pipeline System, which supplies industrial customers in the Corpus Christi area, also will be connected to the plant.

While it is planned that most of the products produced will be shipped by pipeline, facilities for loading tank cars and tank trucks also will be provided.

Included in the over-all expansion program is the installation of about 200 miles of main gathering system pipelines of varying sizes and 250 miles of 26- or 30-inch diameter pipe in the transmission line from Southwest Texas to the Houston area.

The entire program is designed to utilize the gas from a large number of the Company's Southwest Texas fields and will affect producing properties in eight or nine Southwest Texas counties.

Two Board Members Receive Service Pins

Two members of Humble's Board of Directors, Richard J. Gonzalez (left) and Nelson Jones (right), recently were presented Twenty Year service pins by Morgan J. Davis, President.

Dr. Gonzalez, Director in charge of Economics and Statistics and Treasurer of the Company, joined Humble July 1, 1937, as economic advisor. He has been a Director since 1951 and Treasurer since 1953.

Mr. Jones, Director and General Counsel, began his career with Humble in the Law Department June 1, 1937, and has been a member of the Board of Directors since 1956.

Fort Worth Truck Fleet Honored For Safety

Truck fleet drivers at Humble's Fort Worth Bulk Station covered 86,656 miles during 1956 without an accident and by doing so earned top honors in the under-100,000 miles safe driving competition sponsored by the Fort Worth Chapter of the American Society of Safety Engineers.

A plaque was presented to local manager R. F. Green in behalf of employees who had made the safety record possible. James C. Cook was the individual winner in Group V competition, in which Humble placed second.

Guest speaker at the awards presentation was State Highway Patrolman C. E. Crawford from Austin.

Humble Continues Educational Aid

Humble has announced a program of educational aid for the next academic year, continuing a policy of several years standing. Included are graduate fellowships for advanced study, grants to finance high school science teachers' attendance of summer courses, assistance to privately supported colleges, and miscellaneous contributions to special projects in several universities.

Twenty-two graduate fellowships will be awarded at 10 major educational institutions for the academic year 1957-58. These represent a continuation of a fellowships program that has been in effect for the past five years.

Schools at which fellowships are awarded are Texas A&M, Alabama Polytechnic Institute, Georgia Institute of Technology, Louisiana State University, Massachusetts Institute of Technology, Rice Institute, University of California, University of Oklahoma, University of Texas, and Harvard University.

Grants of $3,000 each to the University of Texas and Texas A&M College have been made to assist high school science teachers to attend summer institutes at these two institutions.

Humble's contribution of $50,000 to the Texas Foundation of Voluntarily Supported Colleges and Universities is a continuation of support that has been afforded this organization for several years. Participants are 21 of the privately-endowed colleges in Texas. In Louisiana, six privately endowed colleges are sharing in the Company's gift of $10,000.

Miscellaneous contributions totaling $80,000 have been made to a number of colleges and universities. The funds are used for special projects ranging from agronomy studies to medical education.

Forty Years With the Humble Company

George B. Carroll, at Baytown Refinery, completed 40 years of service with Humble on May 16.

Houston Research Center To Be Expanded

Addition of one new floor and three new wings is part of an expansion program being planned for Humble's Houston Research Center.

Construction contract for the new additions has been awarded to Robert H. Smith and Company of Houston. Total cost of the project including furnishings will be approximately $3 million.

Plans call for a fourth floor to be added to the major portion of the main building, four-story wings on the north and south ends of the structure, and a one-story addition on the north.

The additions will add 65,000 square feet of floor space to the existing building.

Expansion of the Research Center's parking lot and installation of an underground storm water drainage system began in February of this year and has been completed. The parking lot's enlargement added 166 new spaces.

Deaths

Employees: Loyd C. Boguskie, 49, operator at Baytown Refinery, on April 12; Douglas Bradford, 48, lease pumper gauger at Goose Creek, on May 9; Walter S. Branham, 53, engineer at Alice District, on March 24; Willie R. Bryant, 43, roustabout at Grand Isle, on May 11; William E. Cox, 45, senior exploration geologist at Midland, on June 9; James J. Conrad, Jr., 45, roustabout at Avery Island, on March 26.

Claude H. Dunaway, 59, night superintendent at Baytown Refinery, on March 21; Bat Eagleton, 56, laborer at Baytown Refinery, on June 11; Sidney Fitshugh, 35, roustabout at Grand Isle, on May 11; Julius R. Garrett, 46, rotary driller at Greta District, on June 24; John C. Grafft, 57, rotary driller at Stratton District, on March 25.

Guy W. Maley, 49, painter at Baytown Refinery, on April 7; Joseph C. Patterson, 53, helper at Baytown Refinery, on March 26; Corinne C. Strickland, 21, stenographer-special at Baytown Refinery, on June 20; Louis M. Upton, 40, helper at Baytown Refinery, on May 13; Lester E. Wagner, 54, lease pumper gauger at Stratton, on March 28.

Annuitants: William D. Allison, 83, former lease pumper gauger at Dickinson, on April 30; Henry J. Caldwell, 67, former engineer at San Angelo, on April 28; Jesse W. Crockett, 62, former pumper at Government Wells, on April 17; James L. Dunman, 72, former gangpusher at Baytown Refinery, on March 31.

Russell G. Floyd, Sr., 70, former engineer at Benavides Station, on May 9; William H. Gann, 66, former engineer at Cisco District, on April 26; Phillip H. Hollingshead, 68, former water pumper at Baytown Refinery, on April 25; William G. Kennard, 66, former senior supervisory accountant in the Houston Office, on April 14; Daniel T. Monroe, 77, former manager of Retail Sales in the Houston Office, on June 4.

Ransome Owens, 65, former pipeliner at Harbor Island, on March 20; Norman K. Robb, 80, former head of Crude Oil Division Order in the Houston Office, on March 24; Hubert D. Roberts, 67, former lease pumper gauger at London, on March 27; Joseph Rogers, 80, former janitor in the Houston Office, on June 17.

Earle C. Smith, 67, former pumper at Vernon, on April 26; Luther P. Strickland, 55, former assistant mechanical foreman at Odessa, on May 28; Asa I. Taylor, 70, former district gauger at Hull, on May 2; Charles B. Voss, 56, former junior accountant in the Houston Office, on June 20; Lawrence J. Willis, 52, former lease pumper gauger at Laurel, Mississippi, on April 7.

Recent Retirements

HUMBLE PIPE LINE COMPANY

Name	Location	Date of Retirement	Years of Service
Edd Bussa	Hearne Station	May 4	30
Siron L. Cook	Cisco District	June 1	34
Alvie B. Crabb	Satsuma Station	May 17	30
Thomas B. Dill	Ingleside Station	July 3	26
Samuel E. Fulton	Hearne Station	June 10	30
Mack A. Holland	Baytown	June 29	28
Roland T. Richardson	Cisco Div. Office	June 26	23
Jasper J. Smith	Pierce Junction	June 4	36
David L. Swagerty	Foster	May 22	32

PRODUCTION DEPARTMENT

Lawrence J. Barbary	East Texas Division	May 15	30
John L. Brimage	Stratton	April 15	31
I. B. Buckles	Friendswood	May 13	35
John G. Dial	London	June 3	32
Charles M. Gray	Southwest Texas Div. Office	April 1	30
Joe F. Greenup	Conroe	May 8	33
Ellis M. Johnson	Odessa	June 8	22
Reese E. Jones	Jourdanton Gas Plant	July 7	34
Phillip E. Lewis	Snyder	May 10	29
Walter G. Nicol	Hearne Station	May 1	32
Joseph D. Parish	Anahuac	June 1	38
Bill Sisk	Friendswood	April 8	31

BAYTOWN REFINERY

Arthur E. Archer, Sr.	Mechanical Dept.	June 11	37
Claytor Baker	Utilities Dept.	June 1	27
William L. Beckman	Boilermaker Dept.	May 1	32
Ruel H. Benfield	Railroad Dept.	May 1	35
Johnnie L. Berg	Docks Dept.	June 1	28
Eugene F. Block	Carpenter Dept.	April 3	31
Fairy C. Currie	Accounting General	May 27	27
Grover C. Fain	Machinist	April 7	19
Robert F. Gilmore	Instrument	May 31	30
John Gregersen	Service Laboratory	May 30	33
Charles F. Humphries	Electric Shop	July 1	29
Alonzo J. Jackson	Mechanical Dept.	July 10	36
Frank Jones	Railroad Dept.	July 1	37
Ike N. Jones	Storehouse	April 1	34
Everett L. Masterson	Boilermaker Dept.	April 2	33
Lester C. Mitchell	Fluid Catalyst Cracking Unit 1	April 1	33
Floyd B. Norris	Garage	June 6	31
Clyde E. Rodecape	Coordination Dept.	May 8	37
Jesse T. Tubb	Boilermaker Dept.	March 23	36
Steve F. Wolcik	Compound Dept.	July 1	30

SALES DEPARTMENT

Charles C. Cobb	Southwest Tex. Div. Office	April 30	32
Joseph H. Ivey	Specialty Products Mfg. & Fuel Oil Terminal	May 1	24

HOUSTON OFFICE

Alvie Blount	Exploration	May 1	33
Handley B. Burton	Pipe Line Accounting	May 27	28
Isaac R. Cahn	Production Account	April 20	37
Mamie C. Garrett	Office Buildings	April 18	30
Jessie O. Fox	Land Record and Rentals	May 2	39
Edith H. Jones	Refining Dept.	July 1	26
Thomas W. Moore	Training Division	April 30	30
Carl J. Smith	Pipe Line Engineering	May 1	37
Wayne M. Wiggins	Purchasing	April 1	35

By the way

● Gold, oil, and wild onions—all three come together in stories of the Castaic Junction area in California. Joe Tucker writes the oil story on pages 17-21. A few miles from the oil field and 115 years ago, the gold-and-onions story began.

One morning in 1842, rancher Francisco Lopez set out to look for strays. Waking that afternoon from his siesta in an oak's friendly shade,

Oak of the Golden Dream

he recalled a wifely order to bring home some wild onions. Luckily, onions grew nearby and Francisco began to pluck them, shaking grains of dirt from the bulbs.

Suddenly, the sun struck bright rays from a yellow blob tangled in an onion root. Seven years before the famous strike at Sutter's Mill, Lopez had found the first nugget in California! As it turned out, his nugget had few companions and the strike fizzled quickly. The tree under which Lopez took his siesta still stands and is known, appropriately enough, as the Oak of the Golden Dream.

● How many of us can remember, with any degree of precision, the time we chose our life's work?

Humble's President Morgan J. Davis can nail it down to the day. In fact, he can trace it directly to a boyhood birthday present. Speaking in June to the Gulf Coast Petroleum Writers in Houston (see pages 1-3), Mr. Davis said:

"For a good many years now, I've owed a debt of sorts to those of you who deal in the written word. For it was the written word that first turned my thoughts and ambitions to the field of geology.

"On my ninth birthday, up in Fort Worth, an old Scotsman—a friend of my father—gave me a book called *Testimony of the Rocks*, by Hugh Miller. I read the book, studied its pictures and diagrams, and was bitten by the bug. From then on, my sights were set on becoming a rock hound."

Testimony of the Rocks is still a treasured part of Mr. Davis' library.

● Storms (see pages 8-9) can be as capricious as they are destructive. A recent North Texas tornado splintered a home into matchwood—but left on one table a check which had been written and placed there the night before.

Hurricane Audrey, much too vicious to be called a lady, had her unpredictable moments, too, as well as her tragic ones. At Pecan Island, as Walter Beach found out while researching Audrey's story, she filled canals athwart her path with silt and debris. But canals parallel to her terrible winds were flushed out as clean as a well-drained radiator.

● If the men pictured here don't look as if they had just survived a shipwreck, it is only because they

For all hands, a fast rescue

didn't stay long in the water. The *Esso Gloucester*, bound through the Gulf of Mexico for Humble's docks at Harbor Island, rescued all hands (see page 6). Luckily, not a single survivor was injured or sick. And all had time, apparently, to gather personal belongings.

The Humble Way

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Published every other month for employees and shareholders

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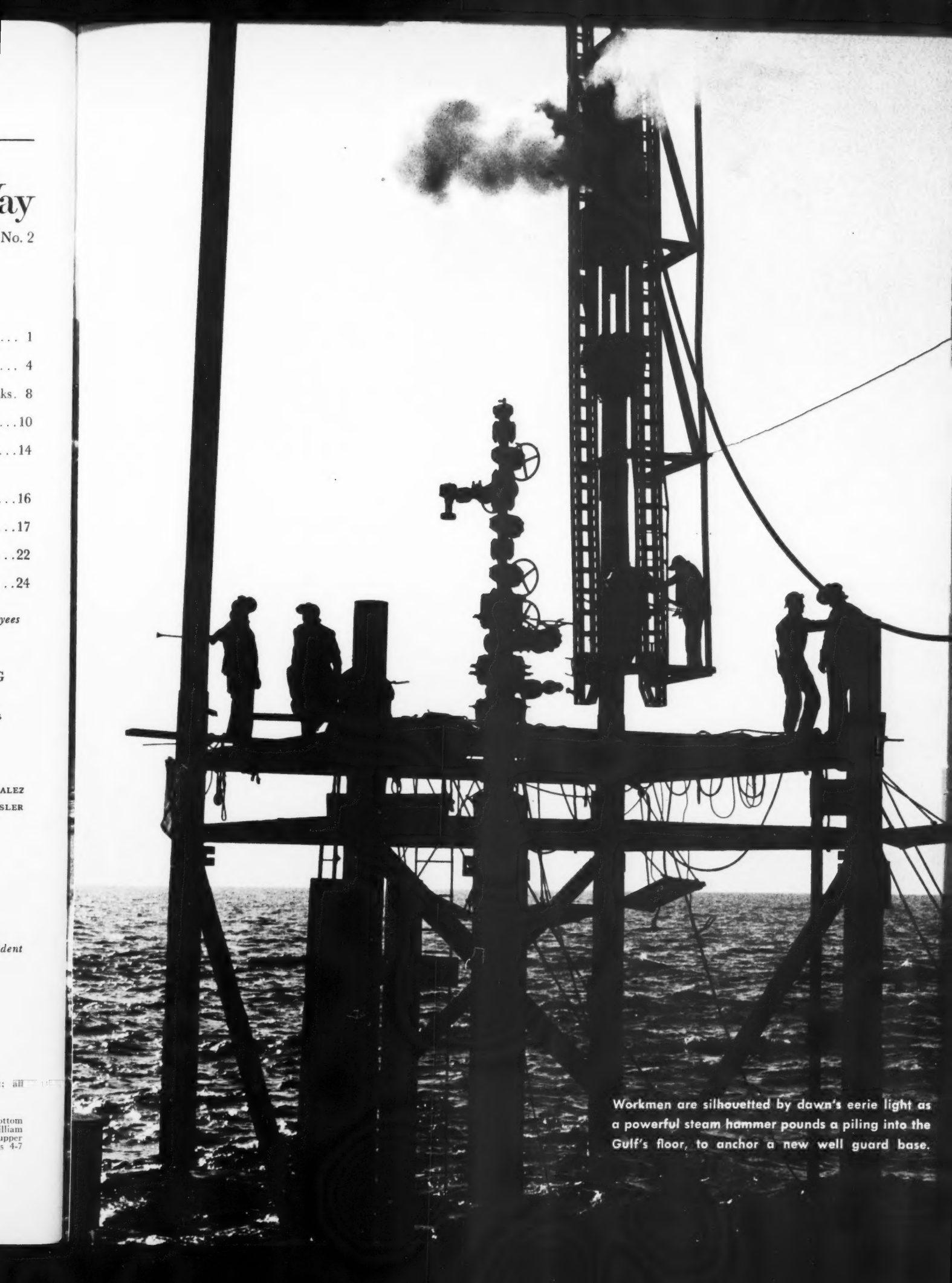

Workmen are silhouetted by dawn's eerie light as a powerful steam hammer pounds a piling into the Gulf's floor, to anchor a new well guard base.